Parametric dependence and optimization of left-handed materials

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Abstract

We studied the transmission properties of one-dimensional meta-materials composed by split ring resonators (SRRs) and metallic wires. The attempt was to understand the behavior of this kind of meta-materials and to use this understanding to achieve large and broadband left-handed transmission.

For that reason we were performing a variety of simulations using different numerical approaches like the transfermatrix method (TMM), finite difference time domain (FDTD) and finite integration technique (FIT). We studied in detail the SRRs spectrum and recognized the various contributions in this spectrum. Moreover, we identified the parameters important for left-handed behavior and examined how the characteristic frequencies in the SRR and LHM spectra depend on various of the system parameters, like the rings size and gaps, the rings separation, thickness, orientation, dielectric board etc. Apart of the SRRs we also studied the behavior of a periodic system of wires, both infinite and finite, and the dependence of the meta-material transmission on the wires depth, width and position.

The results of the above mentioned study are (i) a physical picture of the operation of the SRRs and (ii) optimum parameters which are promising for large and broadband left-handed transmission.